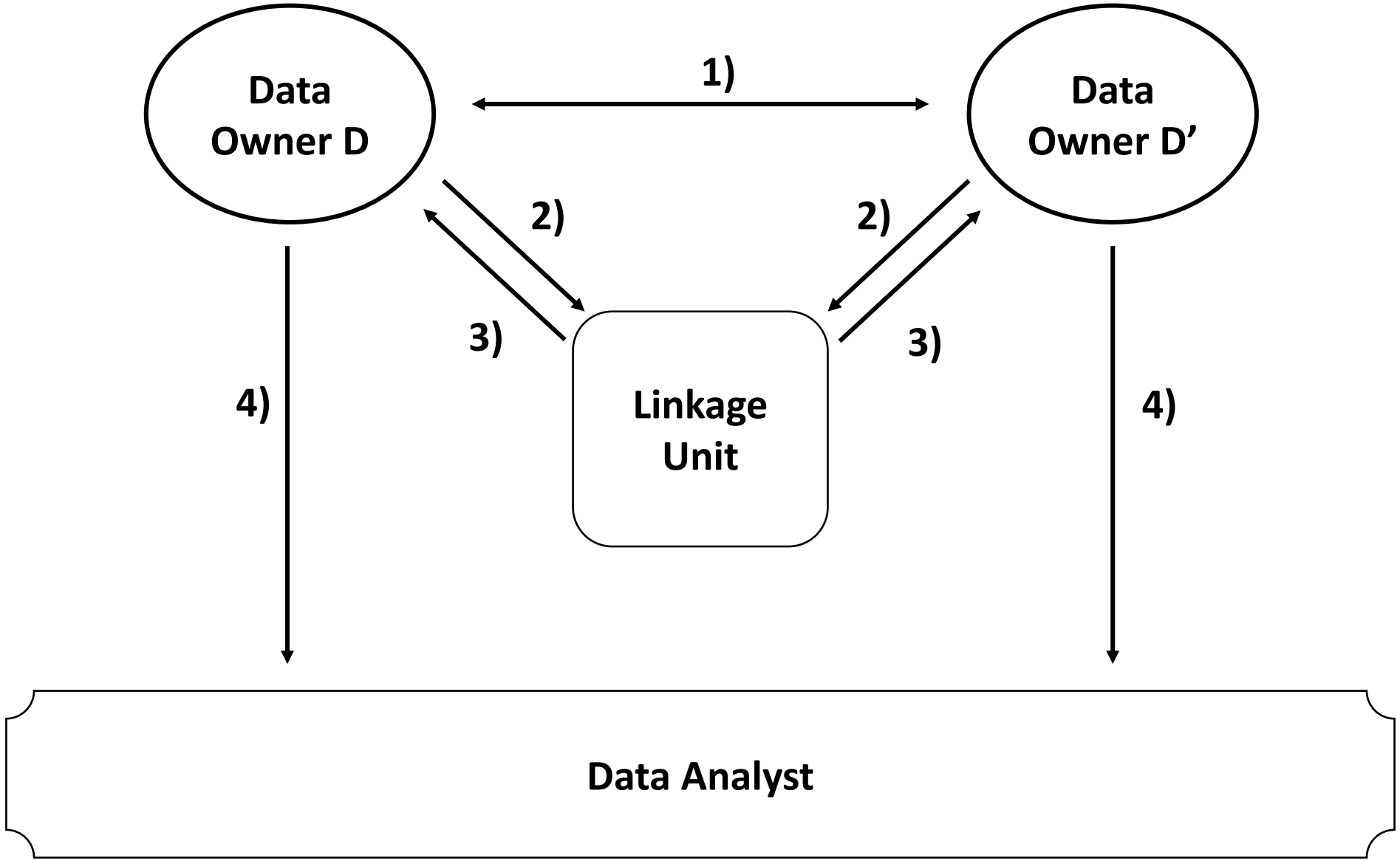
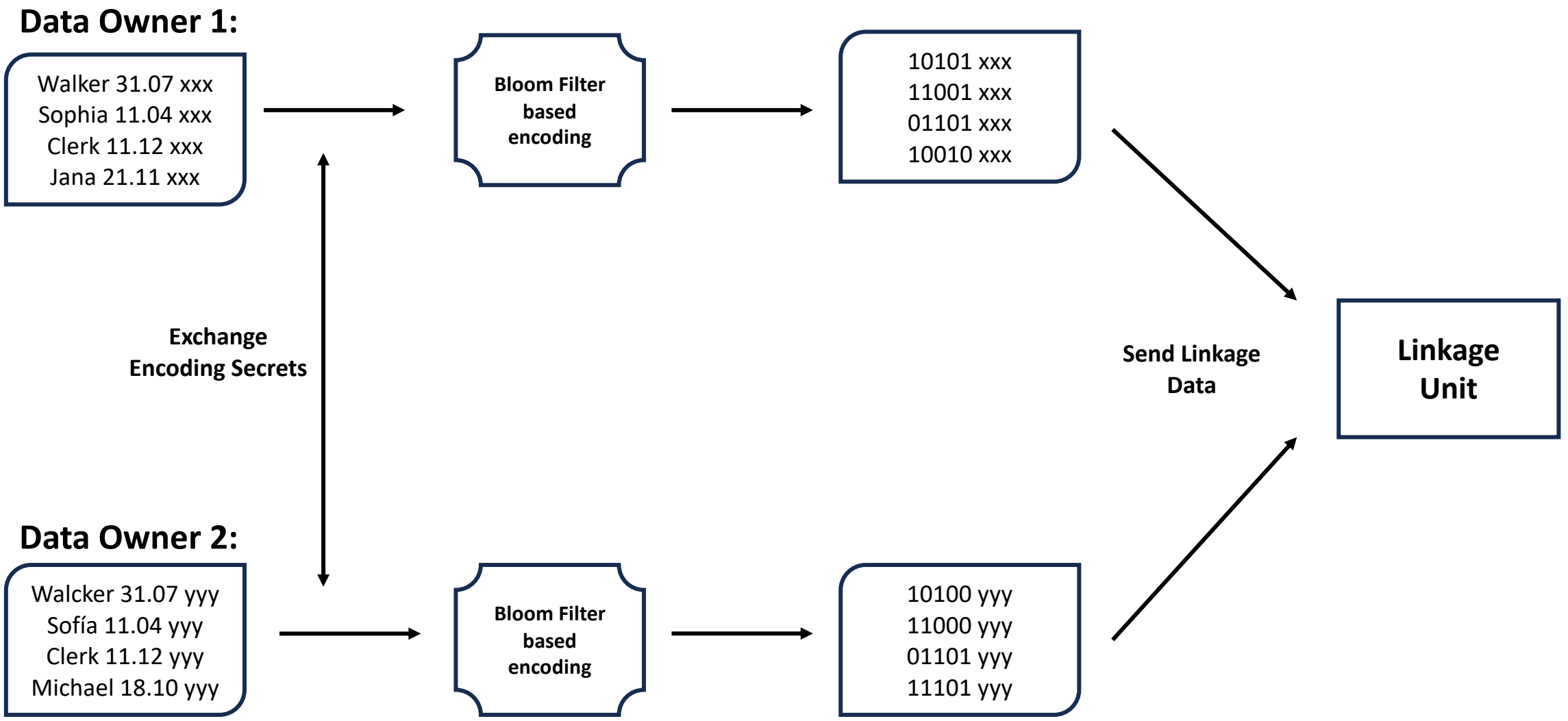
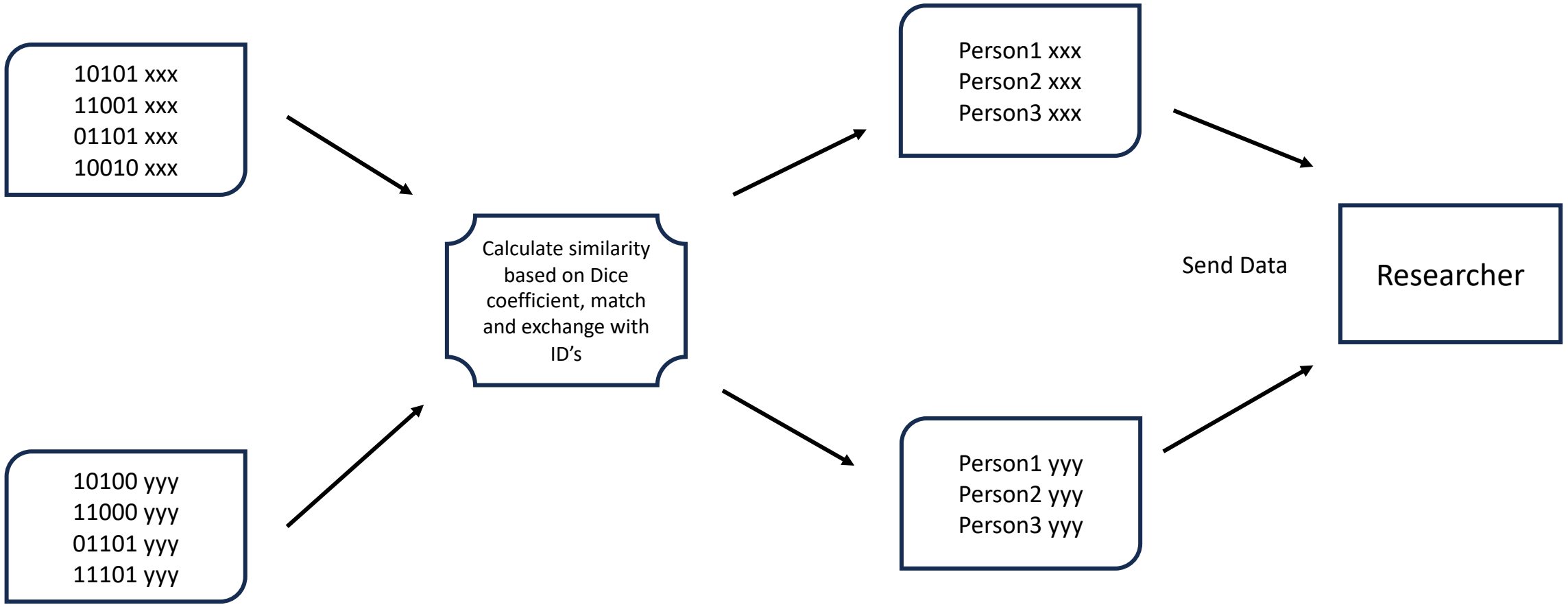
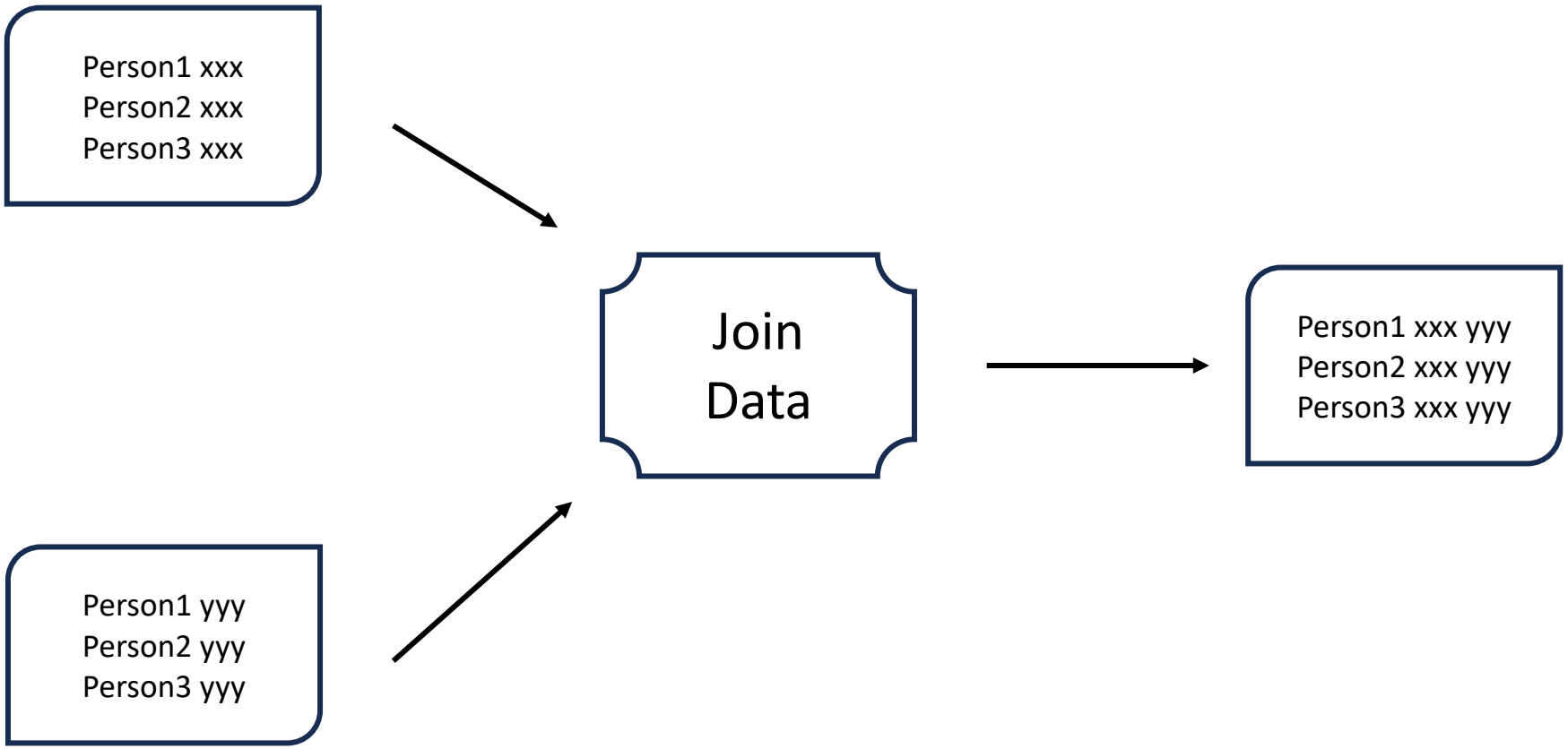

Data
Owner D
1)
Data
Owner D'
2)
2)
3)
3)
4)
Linkage
Unit
4)
Data Analyst

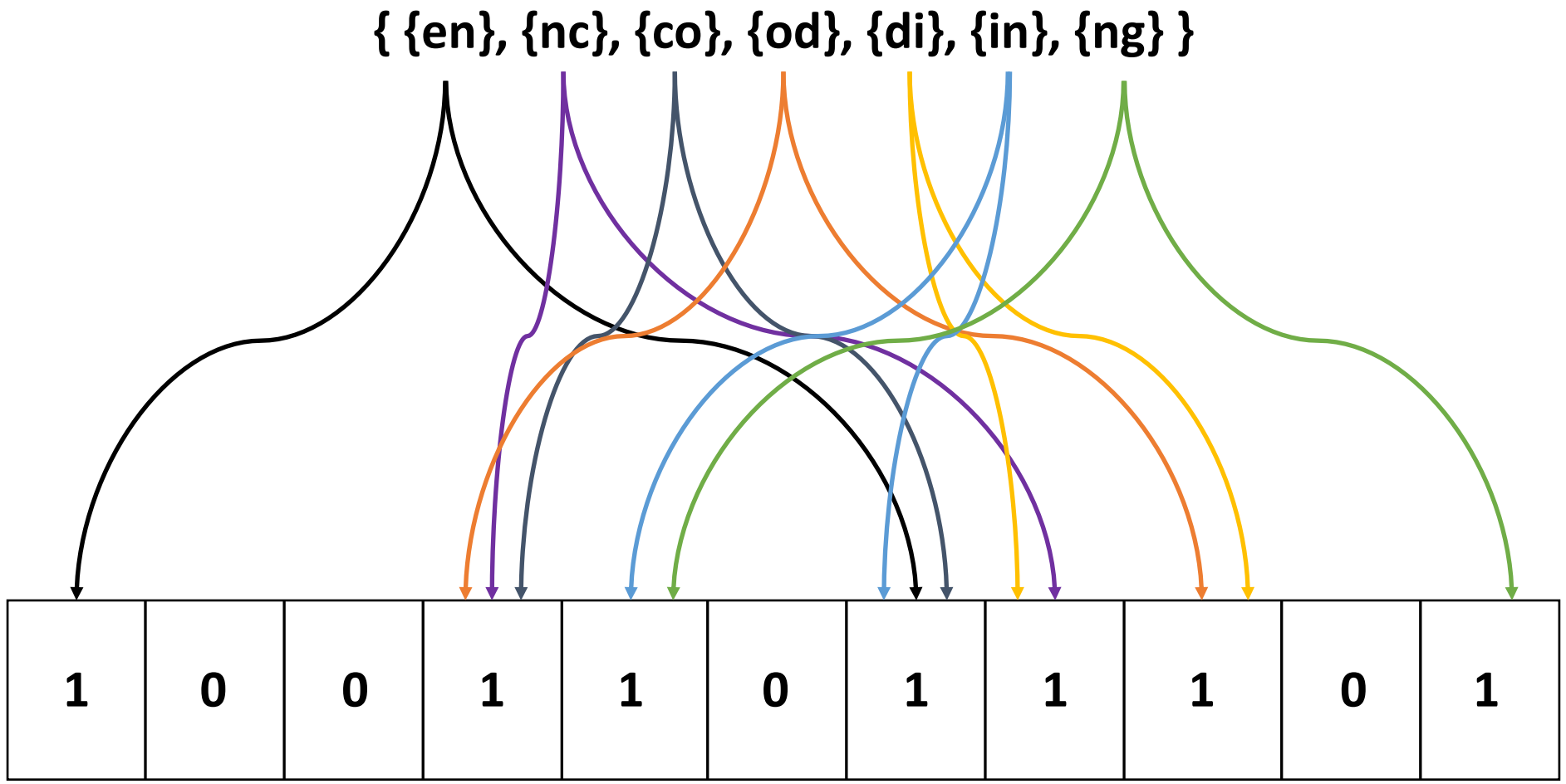

Data Owner 1:
Walker 31.07 xxx
Sophia 11.04 xxx
Clerk 11.12 xxx
Jana 21.11 xxx
Bloom Filter based encoding
10101 xxx
11001 xxx
01101 xxx
10010 xxx
Exchange Encoding Secrets
Send Linkage Data
Linkage Unit
Data Owner 2:
Walcker 31.07 yyy
Sofía 11.04 yyy
Clerk 11.12 yyy
Michael 18.10 yyy
Bloom Filter based encoding
10100 yyy
11000 yyy
01101 yyy
11101 yyy

Linkage Unit:

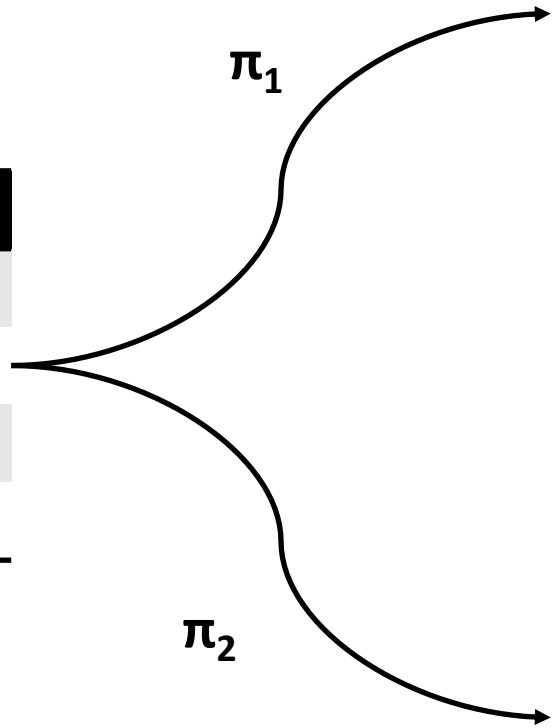


Researcher:


Person1 xxx
Person2 xxx
Person3 xxx
Person1 yyy
Person2 yyy
Person3 yyy
Join
Data
Person1 xxx yyy
Person2 xxx yyy
Person3 xxx yyy


{ {en}, {nc}, {co}, {od}, {di}, {in}, {ng} }
1
0
0
1
1
0
1
1
1
0
1

Index	Element	S	S’
1	1	1	1
2	2	0	1
3	3	1	1
4	4	1	0



Index	Element	S	S’
1	4	1	0
2	3	1	1
3	2	0	1
4	1	1	1

Estimated Jaccard Similarity

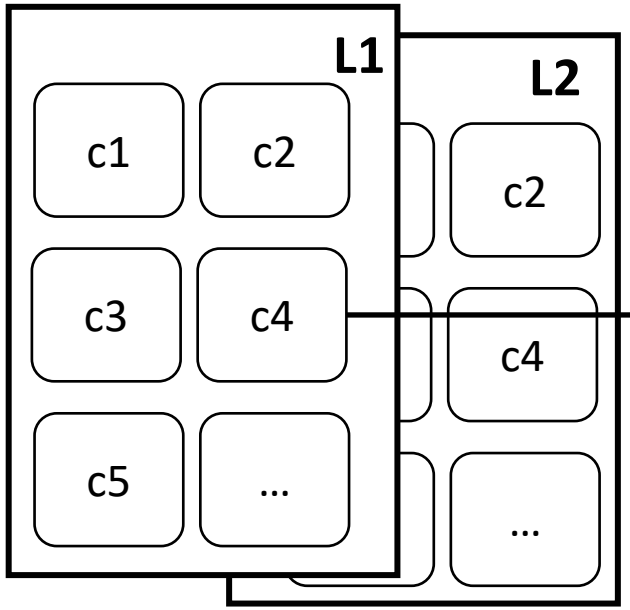
$= [\ 1(\pi_1(S_1)=\pi_1(S'_1)) + 1(\pi_2(S_1)=\pi_2(S'_1))\ ] / 2$

$= (1 * 0 + 1 * 1) / 2$

$= 1/2$

Index	Element	S	S’
1	3	1	1
2	4	1	0
3	2	0	1
4	1	1	1

1) Initialization



Key	Bit string
10	1010
11	0110
01	1001
11	1110

S = { {en}, {nc}, {co}, {od}, {di}, {in}, {ng} }

2) Hashing Process

S_1 = {en} —h_4→ 10010111 —split→ { {10}, {01}, {01}, {11} } —Look up→ { {1010}, {1001}, {1001}, {1110} }

{ {1010}, {1001}, {1001}, {1110} } —XOR→ 0100

$\mathcal{Q}_1$ = {pe, et, te, er}

$\mathcal{H}_1$	**0**	**1**	0	**1**	**0**	**1**	1	**0**
$\mathcal{H}_2$	**1**	**1**	0	**0**	**1**	**0**	1	**0**
$\mathcal{H}_3$	**1**	**0**	0	**1**	**1**	**0**	1	**0**
$\mathcal{H}_4$	**0**	**0**	1	**1**	**0**	**1**	0	**1**

$\mathcal{G}(\mathcal{B}_P)$ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓

E_1 = { **53** , **113** , 42 , **7** , **256** , **87** , 101 , **21** }

$\mathcal{Q}_2$ = {pe, et, te}

0	**1**	0	**1**	**0**	**1**	0	**0**
1	**1**	0	**0**	**1**	**0**	0	**0**
1	**0**	0	**1**	**1**	**0**	0	**0**
0	**0**	0	**1**	**0**	**1**	0	**1**

↓ ↓ ↓ ↓ ↓ ↓

E_2 = { **53**, **113** , **7** , **256** , **87** , **21** }

$$Sim_J(\mathcal{Q}_1, \mathcal{Q}_2) = \frac{|\mathcal{Q}_1 \cap \mathcal{Q}_2|}{|\mathcal{Q}_1 \cup \mathcal{Q}_2|} = 0.75$$

$$Sim_J(E_1, E_2) = \frac{|E_1 \cap E_2|}{|E_1 \cup E_2|} = 0.75$$

S = { {en}, {nc}, {co}, {od}, {di}, {in}, {ng} }

hash →

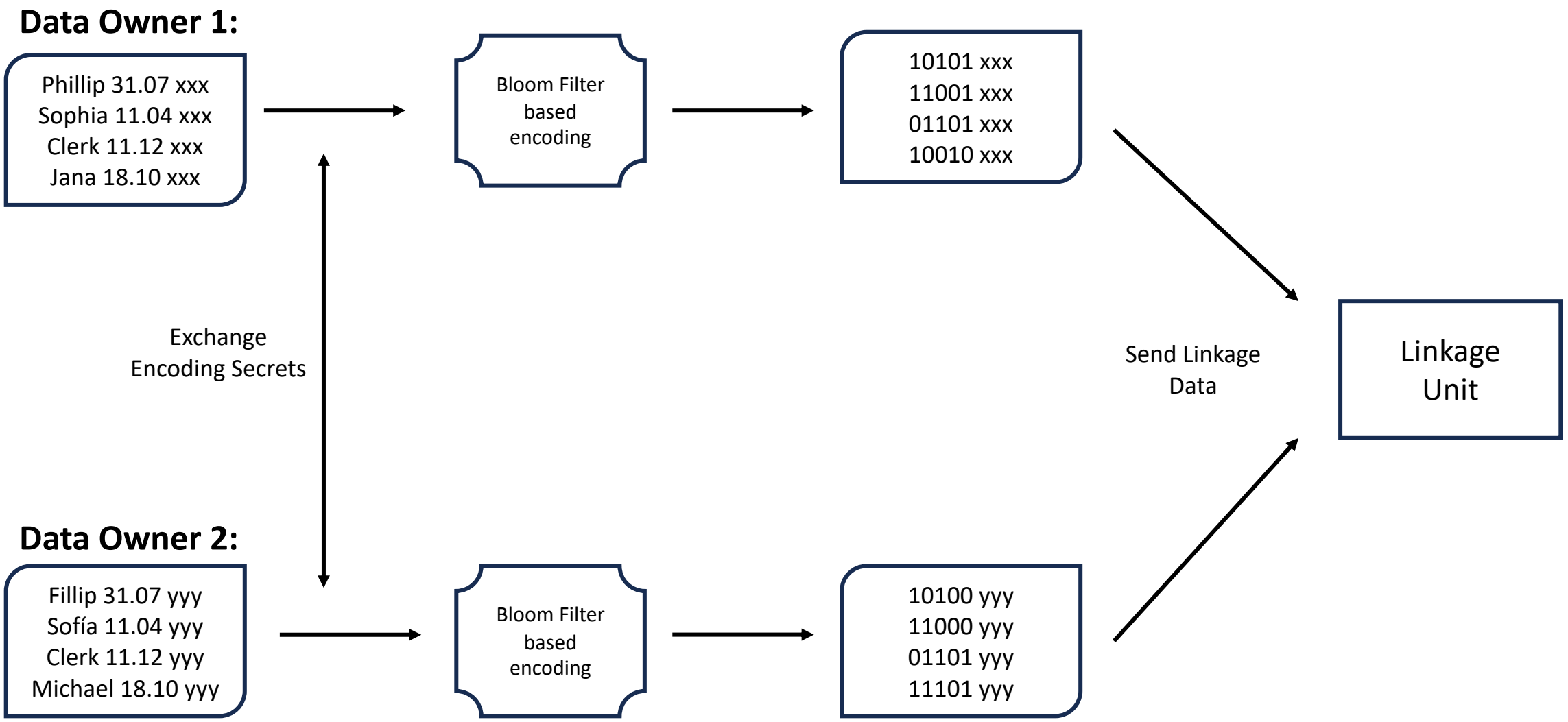
	l1	l2	l3	l4
k_1	1	1	1	0
k_2	1	0	0	0
k_3	0	0	1	0
k_4	1	1	0	0

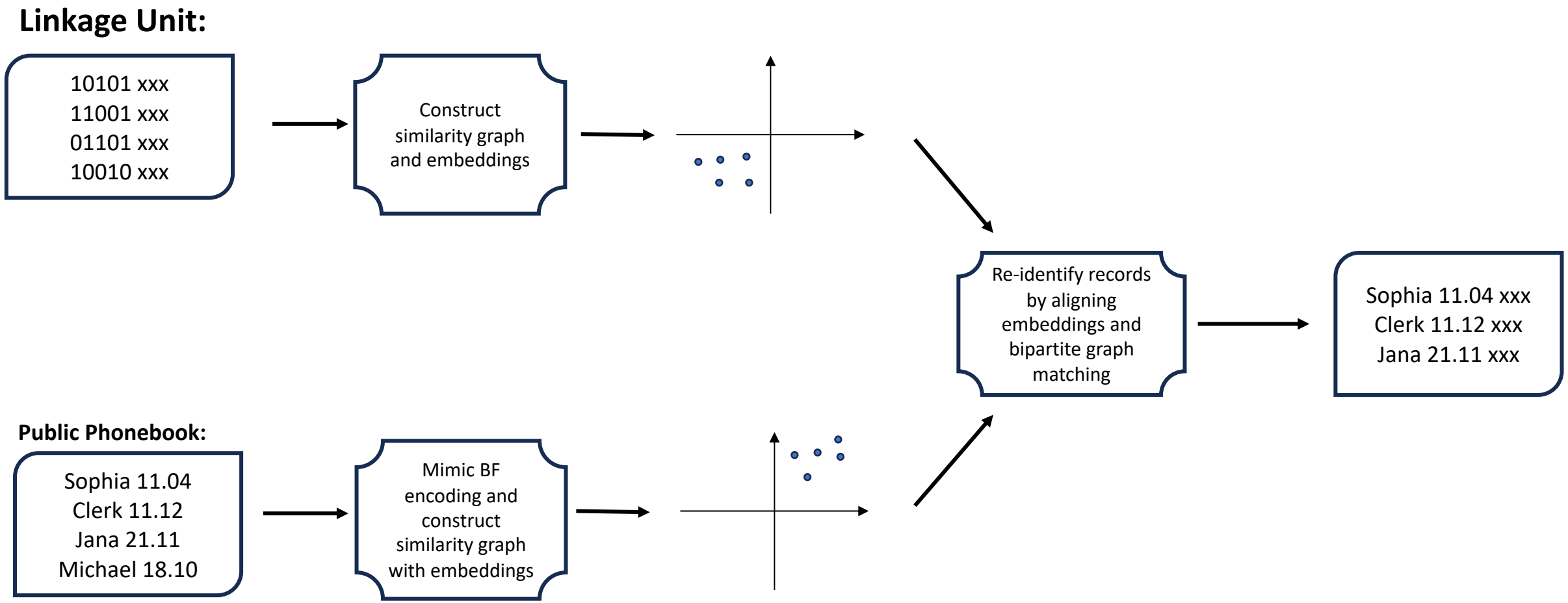
h'_1 h'_2 h'_3 skip

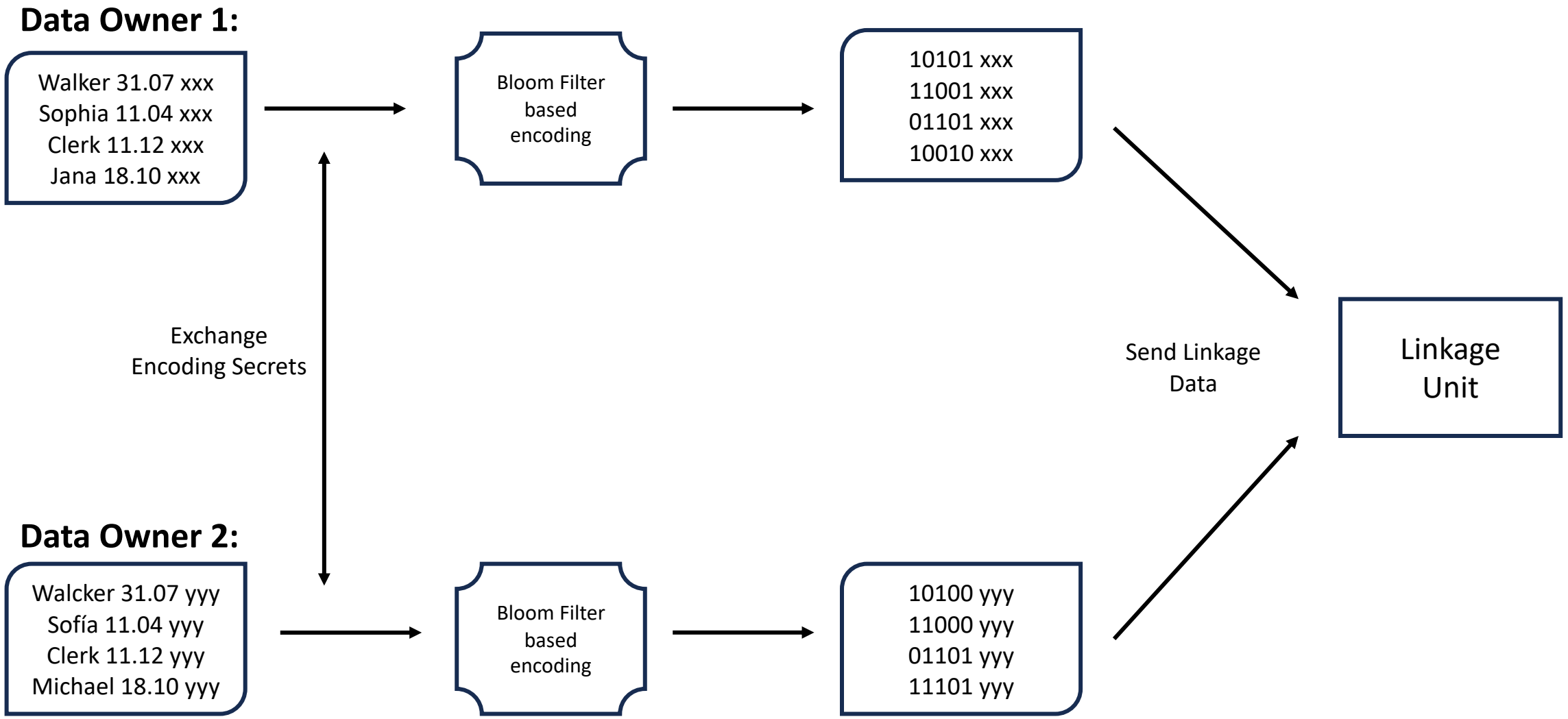
← result

S = { {22}, {13}, {8} }

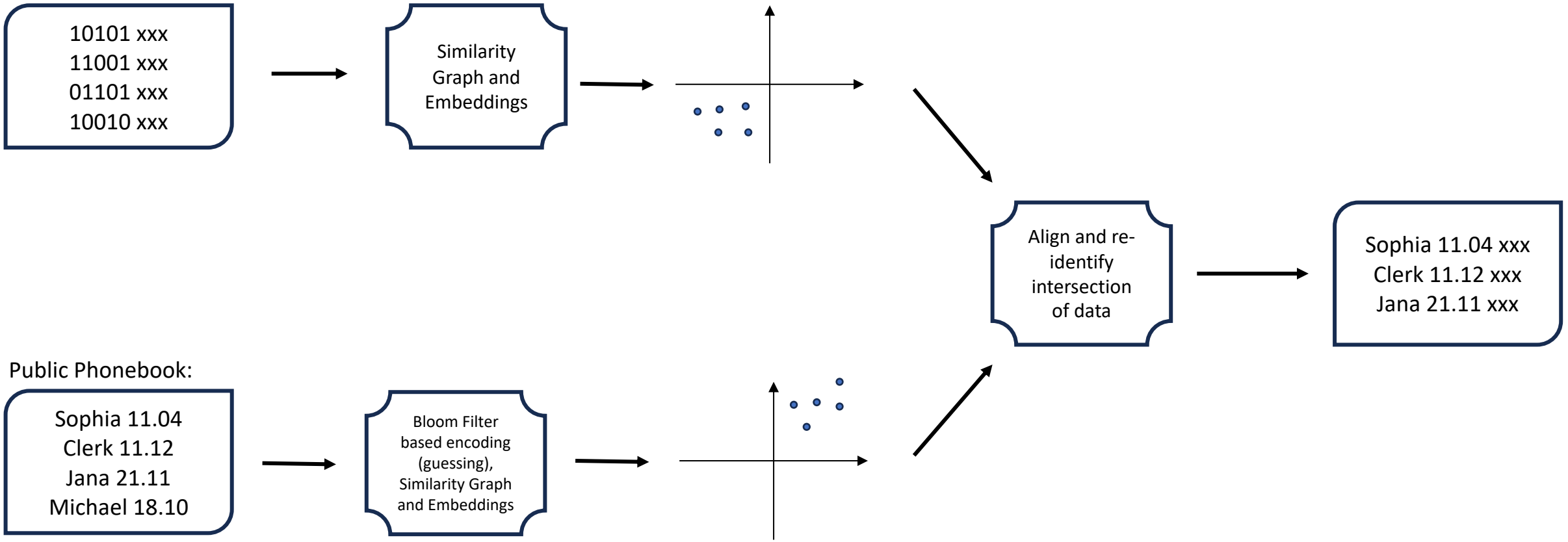
22 **13** **8**


Data Owner 1:
Phillip 31.07 xxx
Sophia 11.04 xxx
Clerk 11.12 xxx
Jana 18.10 xxx
Bloom Filter based encoding
10101 xxx
11001 xxx
01101 xxx
10010 xxx
Exchange Encoding Secrets
Send Linkage Data
Linkage Unit
Data Owner 2:
Fillip 31.07 yyy
Sofía 11.04 yyy
Clerk 11.12 yyy
Michael 18.10 yyy
Bloom Filter based encoding
10100 yyy
11000 yyy
01101 yyy
11101 yyy


Linkage Unit:
10101 xxx
11001 xxx
01101 xxx
10010 xxx
Construct similarity graph and embeddings
Public Phonebook:
Sophia 11.04
Clerk 11.12
Jana 21.11
Michael 18.10
Mimic BF encoding and construct similarity graph with embeddings
Re-identify records by aligning embeddings and bipartite graph matching
Sophia 11.04 xxx
Clerk 11.12 xxx
Jana 21.11 xxx


Data Owner 1:
Walker 31.07 xxx
Sophia 11.04 xxx
Clerk 11.12 xxx
Jana 18.10 xxx
Bloom Filter based encoding
10101 xxx
11001 xxx
01101 xxx
10010 xxx
Exchange Encoding Secrets
Send Linkage Data
Linkage Unit
Data Owner 2:
Walcker 31.07 yyy
Sofía 11.04 yyy
Clerk 11.12 yyy
Michael 18.10 yyy
Bloom Filter based encoding
10100 yyy
11000 yyy
01101 yyy
11101 yyy

Linkage Unit:



Linkage Unit:

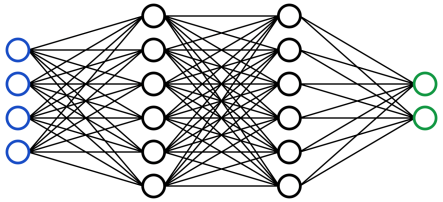
Known:

10101 **Sophia 11.04** xxx
11001 **Clerk 11.12** xxx
01101 **Jana 21.11** xxx

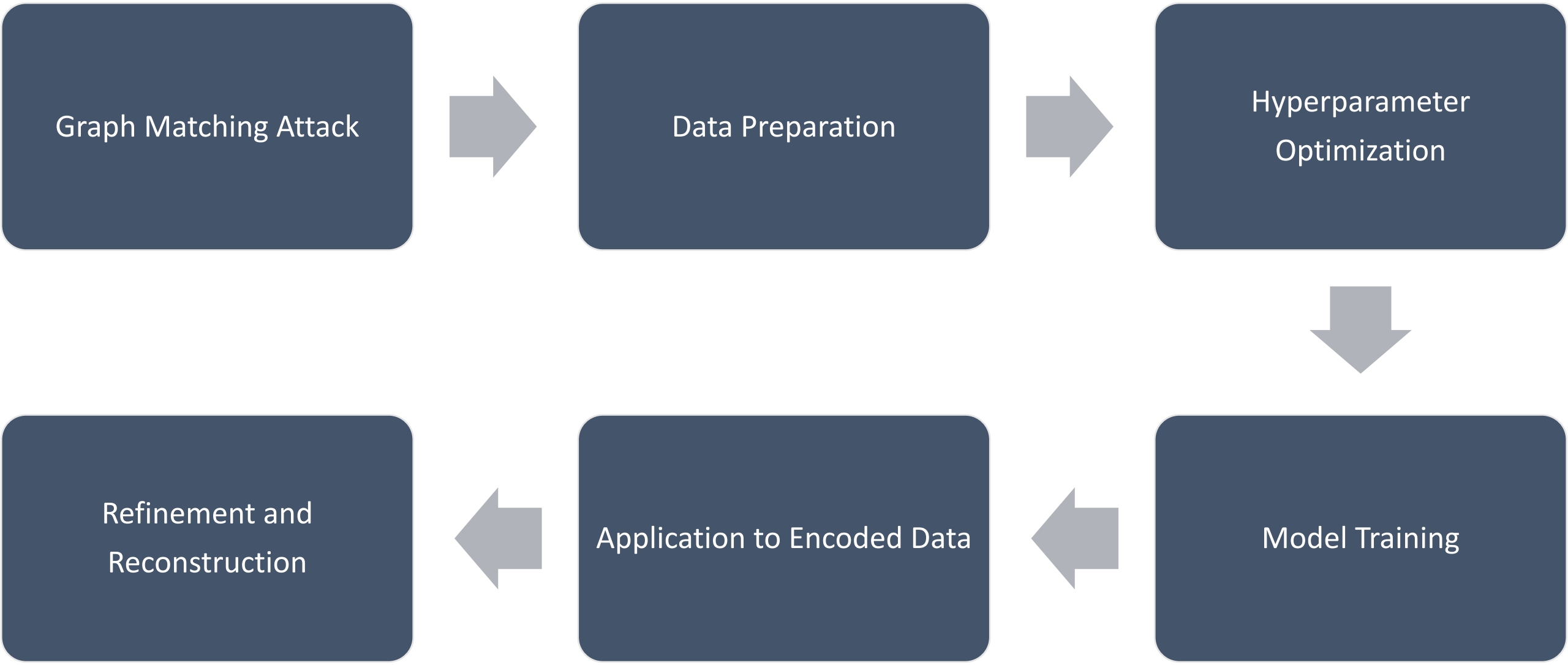
Train Neural Network

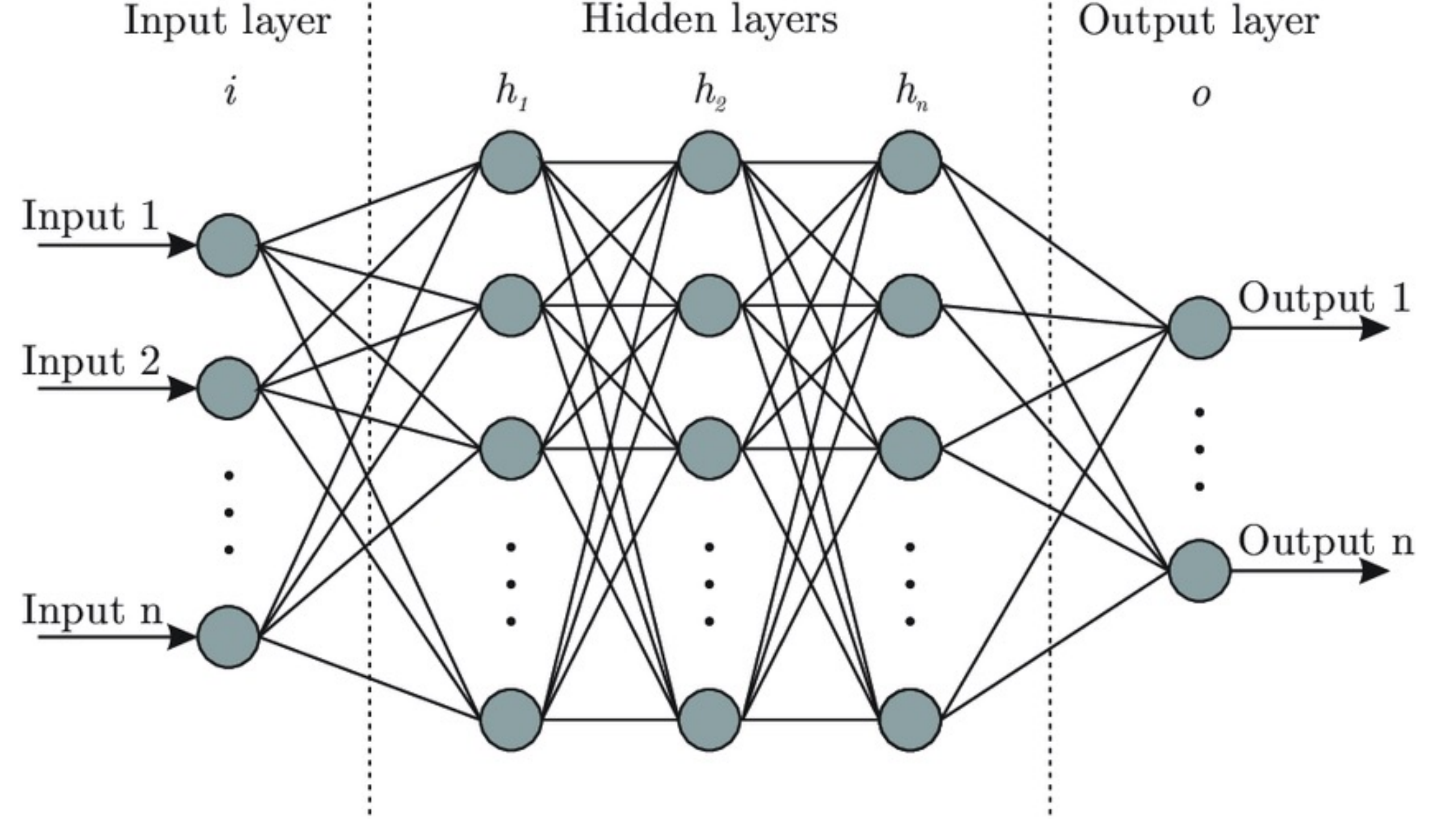
Unknown:

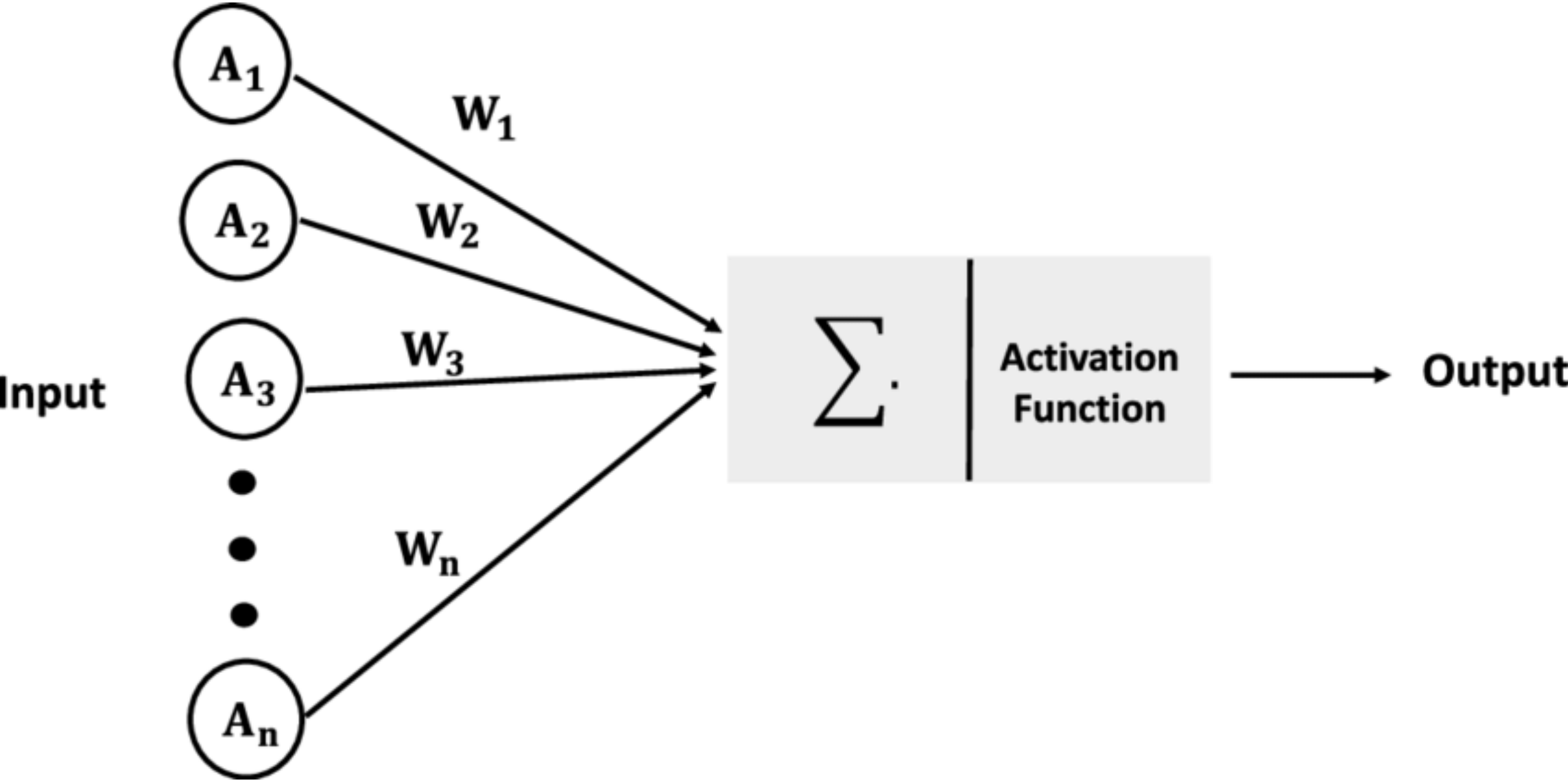
10010 xxx

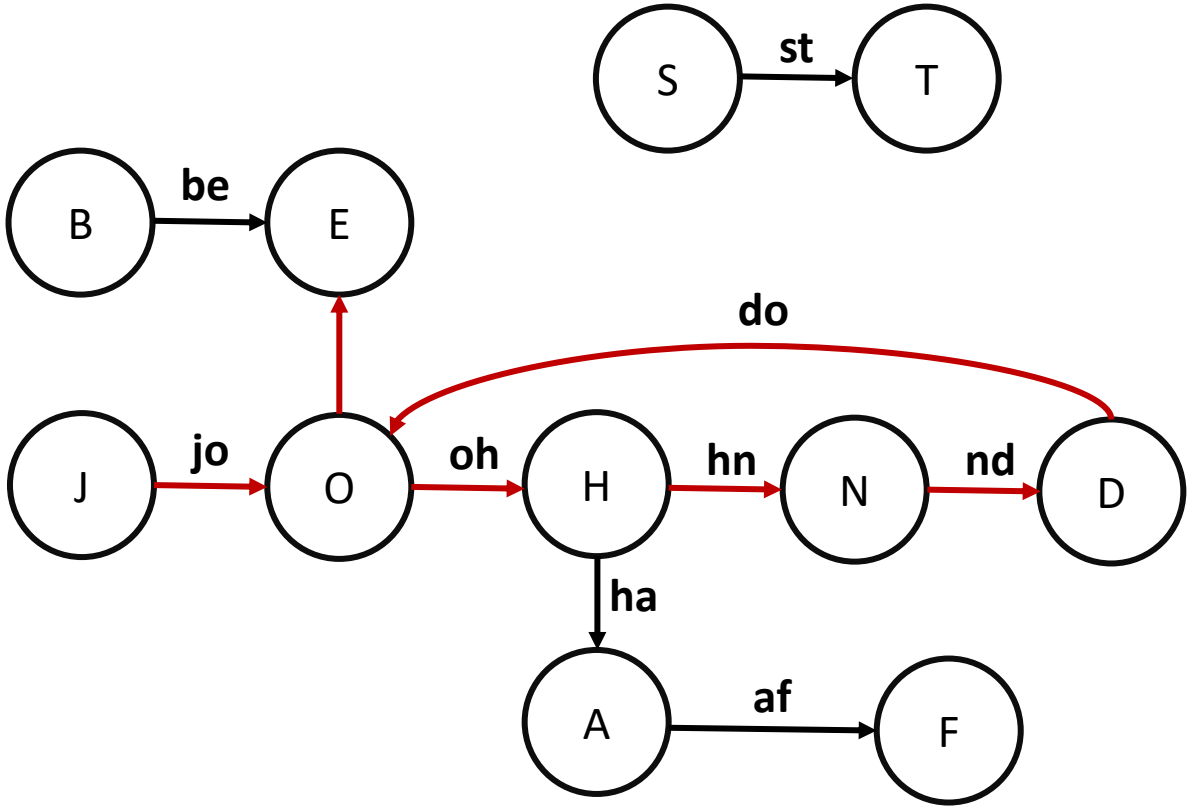


10010 **Walker 31.07** xxx


Graph Matching Attack
Data Preparation
Hyperparameter Optimization
Model Training
Application to Encoded Data
Refinement and Reconstruction


Input layer
Hidden layers
Output layer
i
h_1
h_2
h_n
o
Input 1
Input 2
Input n
Output 1
Output n


A_1
A_2
A_3
A_n
W_1
W_2
W_3
W_n
Input
$\sum$.
Activation Function
Output


S
st
T
B
be
E
do
J
jo
O
oh
H
hn
N
nd
D
ha
A
af
F